

ESTIMATION OF CONSUMER SURPLUS IN MOBILE SERVICES: CASE STUDY ON TELECOMMUNICATION MARKET IN THAILAND

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ABSTRACT

The objective of this paper is to measure the benefits that consumer gain from their consumption of mobile services by estimating the change in consumer surplus (CS). The study considers the mobile telecommunication markets during 2003 – 2012 in Thailand. Detail of measurement principles, literature review, data used for calculation, and calculation results are discussed in this paper.

KEYWORDS: Consumer Surplus, Mobile Services, Calculation, Thailand

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INTRODUCTION

“Consumer Surplus”, in an economic term, means the difference between the price consumers are willing to pay for a good or service relative to the price they actually pay, therefore it is comparable to “Benefits” received by consumers as they will pay less than what they are willing to pay. Calculation methods of consumer surplus can be divided into two principles; i.e., 1) Willingness to pay and 2) Willingness to accept compensation. The calculation can be determined from the area above the price paid by the consumer under a demand curve of any goods or service as shown in Figure 1.

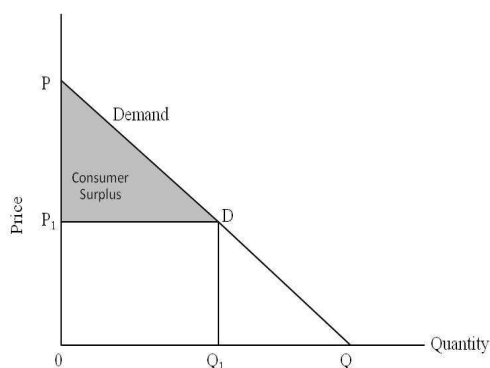


Figure 1: Consumer Surplus [1]

Therefore, factors influencing the consumer surplus consist of the average price paid by consumers, total quantity of goods or services consumed by consumers, and the slope of demand curve that represents the elasticity or sensitivity of demand to the change in price. As abovementioned, the consumer surplus can be estimated from an economic quantitative analysis by using an econometric model as a tool by using either primary or secondary data. Models of analysis can be shown as follows;

Structural Model

A structural model is a model that focuses on relationships between variables and can be described as follows;

The demand of telecommunication services (Y) is defined as a function of the price variable (P) according to economic demand principles and other influencing factors (Z_i) such as income level (INCOME), number of subscribers (SUB), etc. This demand variable (Y) is represented by the consumption of such telecommunication service; for example, average minutes of mobile services per subscriber.

The demand of telecommunication services can be calculated from the following equation.

$$Y = f(P, Z_i) \quad (1)$$

Where the function can be a linear function (eq.2) and

$$Y = \beta_0 + \beta_1 P + \beta_i Z_i + \varepsilon \quad (2)$$

A double-log function (eq.3)

$$\ln(Y) = \beta_0 + \beta_1 \ln(P) + \beta_i \ln(Z_i) + \varepsilon \quad (3)$$

DATA FOR MODEL ESTIMATION

Data for the estimation of the demand of telecommunication services according to econometric principles can be classified as follows;

- **Time Series Data** means data of any variable collected at a certain period of time when an observation is made at every instance of time, e.g., daily, monthly, or yearly, or every 2 or 5 years, etc. An important characteristic for this type of data is its continuity in the time dimension with an equal time interval. This information reflects overall social or economic behaviors, which means it is collected from behaviors of individual business unit or consumer or residence in response to surrounding economic factors. Thus, it is classified as macro- information reflecting balances in that economic sector.
- **Cross-Section Data** means data of any variable collected at any given time, e.g., number of mobile subscribers in 2011, etc. Every observation responses to economic factors at the same period of time, therefore, it will not be influenced by the total time in the studied situation. The observation can be at a micro level such as individual consumer or producer, or at a macro level such as any given region in the country or even the country as a whole. Micro data are often collected from field survey such as questionnaires, telephones and/or other survey tools.
- **Pooled Cross-Section/Time Series Data** means combined data of the time series and cross section data. It may be called “cross section data of time series data” or “time series data of cross-section data”. Pooled cross-section/time series data that are repeatedly collected from the same cross sectional observation at difference time intervals is called “Panel Data”.

LITERATURE REVIEW

The empirical analysis of consumer surplus in telecommunication business has been widely studied for the telecommunication regulation and international academic research. However, in case of Thailand, the estimation of consumer surplus was not included in NBTC Telecommunication Master Plan II Assessment Progress Reports (2008-

2010) in the past 2 ½ years. Examples of international studies on the estimated models for consumer surplus in telecommunication businesses are as follows;

Study of Australian Communications and Media Authority

The study of “Consumer Benefits Resulting from Australian’s Telecommunications Sector” was conducted in 2008 [2] and variables were summarized for three following telecommunication services; 1) Fixed line services, 2) Mobile services and 3) Internet services

Study characteristics: Cross-section data of individual subscriber were used in this study with two variables; i.e., Y represents quantity variable and X represents price variable, as illustrated in Table 1.

Table 1: Quantity and Price Variables for Telecommunication Services Used for Construction of Consumer Surplus Estimation Model [2]

Telecommunication Services	Price Variable	Quantity Variable
Mobile calls	Average revenue per call minute	Call minutes per subscriber
SMS and MMS	Average revenue per SMS/MMS	Number of SMS/MMS sent per subscriber
Fixed line access	Average revenue per subscriber	Number of subscribers
Fixed line local calls	Average revenue per call minute	Call minutes per subscriber
Fixed line national calls	Average revenue per call minute	Call minutes per subscriber
Fixed line international calls	Average revenue per call minute	Call minutes per subscriber
Fixed line mobile calls	Average revenue per call minute	Call minutes per subscriber
Internet data	Average revenue per GB downloaded	GB downloaded per subscriber

Estimating Consumer Surplus in the Mobile Telecommunications Market: the case of Korea

Lee and Lee (2006) studied the estimation of consumer surplus in Korean mobile telecommunication market by applying the time series data for all national data in several time intervals to a simultaneous equation system. This system consists of multiple and related equations where variables in some equations are jointly defined and interdependent [3].

The equation system used in this research can be defined as the following function.

$$Q = Q(p_s, p_c, p_z, N, I) \quad (4)$$

Where p_s = Price of network access

p_c = Price of a Call

p_z = Prices of other goods in the economic system (represented by Consumer price index)

I = User’s income

N = Network Size

The studied results are shown in Table 2 and 3 below.

Table 2: Example of Composition of Prices of Network Access (p_s) and a Call (p_c) for Services from Network Provider [3]

+ Subscription deposit (or guarantee insurance fee) + Activation fee + Monthly subscription charge + Handset expense - Handset subsidies	One-off One-off Monthly One-off One-off	+ Normal (weight =0.65) + Night (weight =0.30) + Mid-night (weight =0.05)	Marginal (10s) Marginal (10s) Marginal (10s)
= Price of network access	Monthly	= Price of a call	Marginal (min)

Table 3: Estimation of Elasticity of Demand from Ordinary Least Squares Method and Generalized Least Squares Method based on Data before and after July 1998 when Competition Promotion Policy was implemented. [3]

Period	Precompetition (January 1996-July 1998)			Post competition (July 1998-December 2004)				
Model	(1)	(2)	(3)	(1)	(2)	(3)	(4)	(5)
Method	OLS	GLS	GLS	GLS	GLS	GLS	GLS	GLS
Price of access	0.408** (2.357)			-0.030 (-0.455)				
Price of a call	-0.194 (-0.792)	-0.922** (-2.224)	-0.941** (-2.131)	- 0.599*** (-1.755)	- 0.556*** (-1.691)	-0.643** (-1.923)	-0.482** (-1.909)	-0.609** (-2.305)
Income	1.478* (5.539)	1.595* (3.819)	1.099* (3.008)	0.655* (4.002)	0.654* (4.044)	0.637* (3.417)	0.637* (4.196)	0.626* (3.631)
Number of subscribers	1.355* (2.808)	0.947*** (1.955)		0.502** (2.387)	0.486** (2.390)		0.482** (2.419)	
Forecasted value of the number of subscribers			0.699 (1.649)			0.402** (2.012)		0.404** (2.044)
Time trend	-0.98* (-2.949)	-0.102** (-2.601)	-0.071** (-2.515)	-0.002 (-0.508)	-0.001 (-0.352)	-0.000 (-0.164)		
Constant	-14.051 (-1.580)	-0.839 (-0.093)	6.363 (0.966)	9.894* (3.053)	9.647* (3.114)	11.613* (4.148)	9.511* (3.156)	11.514* (4.248)
Adjusted R ²	0.934	0.922	0.918	0.983	0.982	0.982	0.982	0.982
D-W stat.	1.582	1.442	1.509	0.971	0.850	0.838	0.834	0.824

Note: *, **, *** represents significant levels of 1%, 5%, and 10%, respectively, and the value in the parenthesis means t statistics.

The study by Lee and Lee (2006) uses results from simultaneous equations to estimate the elasticity of demand by using the variable predicted from the network size (N) as the instrumental variable. Consumer surplus can be determined from the elasticity of demand in table 3.

Estimating Demand Curve in the Korean VoIP Telecommunication Market

Kwak and Lee (2011) studied the demand equation of voice over internet protocol (VoIP) from the following equation [4].

$$\ln Q_1 = \alpha_0 + \alpha_1 \ln P_{Vt} + \alpha_2 \ln P_{Lt} + \alpha_3 \ln P_{Mt} + \alpha_4 \ln N_t + \alpha_5 \ln Y_t + \varepsilon_t \quad (5)$$

Instrumental variables for the estimation in equation (5) will be lagged terms of those variables. Therefore, these instrumental variables consist of

$$\ln P_{Vt-1}, \ln P_{Lt-1}, \ln P_{Mt-1}, \ln N_{t-1}, \ln Y_t, \ln Q_{t-1} \quad (6)$$

Where Q_c = Quantity of VoIP services

P_{Vt} = Call rate of mobile service

P_{Mt} = Call rate of fixed line service

N = Number of VoIP subscribers

Y = Income

Estimating Demand Elasticities for Mobile Telecommunication in Austria

Dewenter and Haucap (2004) studied the demand for mobile services in Austria by using panel data or pooled cross section/time series data from operators in different time intervals. Estimation of fixed effects and Dynamic Panel Data model were used in this study and the quantity of mobile services was determined from the equation below [5].

$$\ln q_{it} = \gamma_{it} + \delta_1 \ln q_{it-1} + \delta_2 \ln p_{it} + \sum_{k=3}^K \delta_k x_{it,k} + \varepsilon_t \quad (7)$$

Where the number of subscribers is another explanatory variable (X) in addition to the price of a call (P) and the lagged variable for the quantity of services (q_{it-1})

The demand for International Telecommunication in Italy

Manenti (2001) studied the demand for international telecommunication services in Italy and the following equations were used in his study [6].

$$Q_{ita,t}^i = \beta_0 + \beta_1 P_{ita,t}^i + \beta_2 Q_{ita,t}^{ita} + \beta_3 Y_{ita,t} + \beta_4 NTET_{i,t} + \beta_5 TEL_{ita,t} + \beta_6 TOUR_{i,t}^{ita} \quad (8)$$

$$Q_{i,t}^{ita} = \gamma_0 + \gamma_1 P_{i,t}^{ita} + \gamma_2 Q_{ita,t}^i + \gamma_3 Y_{i,t} + \gamma_4 NTET_{i,t} + \gamma_5 TEL_{i,t} \quad (9)$$

Where i = 1, 2, ..., 14 is the index for the designated country of international calls from Italy

t = 1991...1997 is the time period of study

$P_{i,t}^i$ = Call rate from Italy to the designated country i

$Q_{i,t}^i$ = Minutes of calls from Italy to the designated country

$Y_{i,t}$ = National income per capita of the designated country i

$NET_{i,t}$ = Number of internet connections in Italy and the designated country

$TEL_{i,t}$ = Number of access lines in the designated country

$TOUR_{i,t}^{ita}$ = Number of tourists from the designated country travelling to Italy

CALCULATION OF CONSUMER SURPLUS

From economic point of view, consumer surplus can be calculated from the area above the horizontal line of the actual price of the demand curve. Thus, a calculated formula for consumer surplus is dependent on characteristics of its analyzed functions.

Straight Line Demand Function

In case that the change in demand due to changes in non-price factors is a straight line function where a price reduction results in an increase in the quantity of services, then the consumer surplus can be calculated from equation (10) as follows;

$$\Delta CS = [(P_1 - P_2) * Q_1] + \left[\frac{1}{2} (P_1 - P_2) * (Q_2 - Q_1) \right] \quad (10)$$

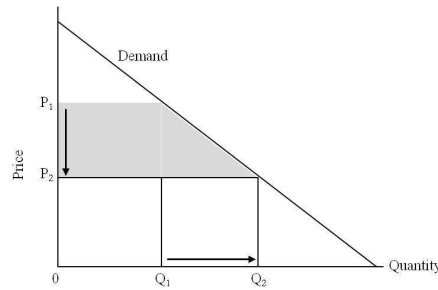


Figure 2: Measurement of an Increase in Consumer Surplus due to Price Reduction [2]

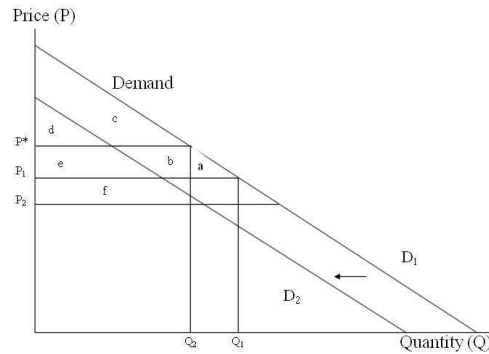


Figure 3: Calculation of Consumer Surplus in case of Demand Change Due to Changes in Non-Price Factors [2]

Figure 3 shows a decrease in demand due to non-price factors as the demand line moves from D_1 to D_2 . Consumer surplus will change from the area of “ $a + b + c + d + e$ ” to “ $d + e + f$ ” and the demand will drop in the amount equivalent to the area “ $a + b + e$ ”, which can be measured from equation (11).

$$[(P^* - P_1) \times Q_1] + \left[\frac{1}{2} (P^* - P_2) \times (Q_2 - Q_1) \right] \quad (11)$$

Log-Linear Demand Function

According to Lee and Lee (2006), the consumer surplus for a log-linear demand function can be calculated from the following equation [3].

$$Q = e^{x_0} P_s^{x_1} P_c^{x_2} N^{x_3} Y^{x_4} \quad (12)$$

Where $P_s = p_s/\text{CPI}$, $P_c = p_c/\text{CPI}$, $Y = I/\text{CPI}$ and $\alpha_0, \alpha_1, \alpha_2, \alpha_3$ are parameters.

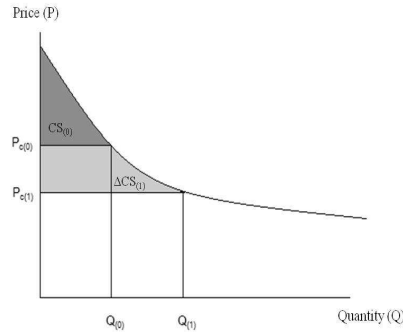


Figure 4: An Increase in Consumer Surplus Due to Price Reduction for Non-Linear Demand Function [3]

As the demand function is non-linear, the area under the curve will be determined by integration as expressed in equation (13).

$$\Delta CS_{(t)} = \int_{P_{c(t-1)}}^{P_{c(t)}} Q_{(t)}(p_s, x, p_z, N, I) dx = \int_{P_{c(t-1)}}^{P_{c(t)}} e^{x_0} P_s^{x_1} x^{x_2} N^{x_3} Y^{x_4} = \frac{e^{x_0} P_s^{x_1} (P_{c(t)}^{1+\alpha_2} - P_{c(t-1)}^{1+\alpha_2}) N^{x_3} Y^{x_4}}{1+\alpha_2} \quad (13)$$

Where $\Delta CS_{(t)}$ represents an increase in consumer surplus due to price reduction from $P_{c(0)}$ to $P_{c(1)}$ as shown in Figure 4 above

Consumer surplus at $t = 0$ can be calculated from

$$\Delta CS_{(0)} = \int_{P_{c(0)}}^{P_c} Q(p_s, x, p_z, N, I) dx \quad (14)$$

In addition to the straight line estimation or the estimation by instrumental variables as described above, there are other methods that can be applied for the calculation such as nested logit or multinomial logit discrete choice model. This model can determine the elasticity by focusing on the decision to choose various packages by consumers, as described in the study by Srinuan and Bohlin (2011) [9]. In some cases, the model will emphasize on willingness to pay (WTP) by consumers, e.g., the study by Rosston, et al.(2011) [10]. However, these studies will not be discussed in detail as they do not meet the main objectives of this project.

CALCULATION OF CONSUMER SURPLUS IN MOBILE BUSINESS

In this report, the analysis of consumer surplus will firstly begin with mobile services since this business has the most complete data in all four telecommunication businesses. Data used in this study are referenced from the telecommunication regulator of Thailand (NBTC) Database.

Analyzed Variables

The quantity variable (Y) represents the demand of mobile services and is defined as minutes of use (MOU) per month per subscriber averaged from all service providers.

As NBTC's database does not contain complete data of rate per minute (RPM) for all time intervals, so average revenue per user (ARPU) is instead used this study. Accordingly, the price variable (P) is defined as the division of ARPU

by MOU (industrial average) per month per subscriber (in Baht/minute).

Other variables (Z_i) influencing the quantity of services from the empirical study as noted in section 3.4 consist of Income (I) represented by Real GDP and Number of mobile subscribers (SUB).

The calculation is based on the log-linear function following the study by Lee and Lee (2006) and the demand equation can be described as follows [3];

$$Y = e^{\alpha} P^{\beta_1} I^{\beta_2} SUB^{\beta_3} \quad (15)$$

And in Log-linear terms as

$$\ln Y_t = \alpha + \alpha_1 \ln P_t + \alpha_2 \ln I_t + \alpha_3 \ln SUB_t + \varepsilon_t \quad (16)$$

Data used for the calculation are quarterly time series data from Q1/2002 to Q4/2012, as shown in figure 5.

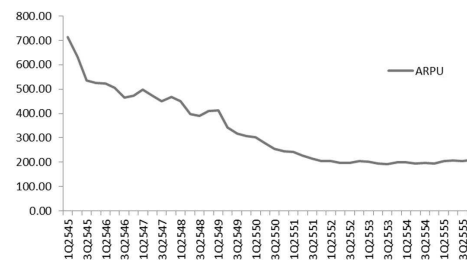


Figure 5: Average Revenue per User (ARPU, industrial average) for Mobile Services [7]

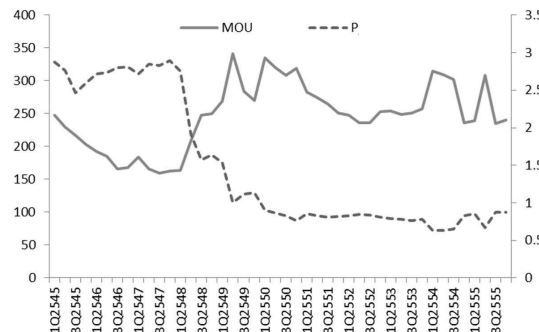


Figure 6: Minutes of Use (MOU, industrial average) and Call Rate per Minute (P, industrial average) for Mobile services

Source: Data of MOU (industrial average) are collected from Thai Telecom Database (NBTC) and data of call rate per minute are calculated from ARPU (industrial average) divided by MOU (industrial average)

Figure 5 indicates a downward trend of ARPU (industrial average) since 2002 from 714 Baht/month/subscriber in Q1/2002 to 200 - 300 Baht. In Q4/2006, ARPU (industrial average) was at 307 Baht/month/subscriber and down to 210 Baht in Q4/2012. In addition, the decline rate of ARPU was high during 2005-2006 and tended to be stable at approximately 200 Baht/month/subscriber after 2009.

Figure 6 shows a stable call rate per minute (industrial average) at 2.5 Baht/minute during 2002-2004 and was at 2.88 Baht/minute in Q1/2002. The call rate declined rapidly during 2005-2007 to 0.80-1 Baht/minute (call rates/minute were at 1.64, 1.14, and 0.76 Baht in Q4 of 2005, 2006, and 2007, respectively) and tended to be stable after 2007. The call rate dropped to 0.60-0.70 Baht/minute for a short period during Q1/2011 (0.63 Baht/minute) to Q3/2011 (0.65 Baht/minute)

before climbing up to 0.87 Baht/minute in Q4/2012.

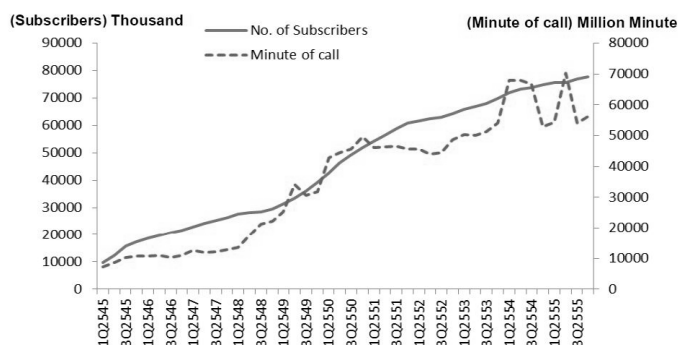


Figure 7: Number of Subscribers and Total Minutes of Call for Mobile Services

Source: Number of subscribers (SUB) were collected from Thai Telecom Database and total minutes of call per quarter were calculated from MOU (industrial average) * number of subscribers * number of months in a quarter (MOU * SUB * 3)

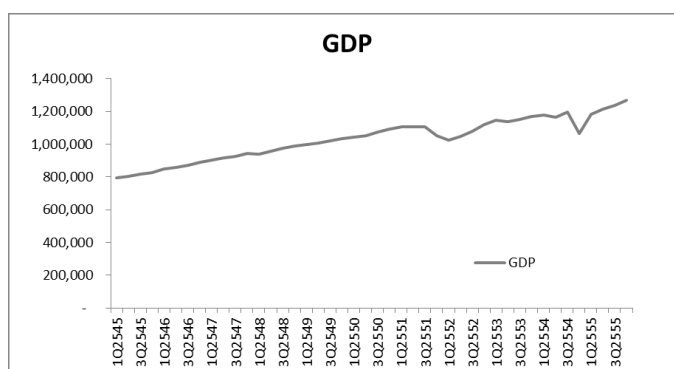


Figure 8: Gross Domestic Product (GDP) [7]

During 2002-2004, MOU (industrial average) constantly declined from 248 minutes per subscriber per month in Q1/2002 to 162 minutes in Q4/2004. After the price reduction in 2005, MOU climbed up to 250, 270, and 310 minutes per subscriber per month in Q4 of 2005, 2006, and 2007, respectively. After that, MOU dropped slightly and the latest MOU was at 241 minutes per subscriber per month in Q4/2012.

According to figure 7, growth rates of the number of subscribers were higher than those of MOU in almost all time intervals during 2002-2012, except during 2005-2006 when MOU grew rapidly as indicated in figure 6. Furthermore, in some intervals, for example, during 2007-2009, the number of subscribers increased while the total minutes of call were stable, reflecting a decline in MOU during that period. (Data from figure 6). The latest data in Q4/2012 indicated 83.88 million subscribers which increased from 9.67 million subscribers in Q1/2012. The increase in number of subscribers is an important factor leading to a continued increase in total minutes of use (total minutes of call) although minutes of use per subscriber per month are stable or decline in some periods. A continued increase in total minutes of use for mobile services can be used as a preliminary indicator on benefit levels received by consumers and consumer surplus that tends to increase continuously.

The consumer income can be reflected through Thailand's gross domestic product (GDP). As seen in figure 8, GDP had grown constantly during 2002-2012, except during the 2008 global financial crisis and the flood crisis in Thailand during Q4/2011 to Q1/2012.

Based on above quarterly data from 2002 to 2012, the estimated demand of mobile services can be calculated from equation (17) as follows;

$$\ln \hat{Y}_t = 2.335 - 0.760 \ln P_t + 1.158 \ln I_t - 0.725 \ln SUB_t \quad (17)$$

(t – statistic) (0.908) (–21.291) (4.861) (–12.703)

$$R^2 = 0.94, \text{Standard Error of Regressin} = 0.05$$

The above estimation shows the price elasticity of mobile service demand at -0.760, which is below 1, indicating a decrease in total revenues if the service provider reduces the price down because the quantity of services, will grow slower than the price reduction. On the contrary, the above equation shows the income elasticity at 1.158. It is noted that minutes of use per subscriber is inversely proportional to the number of subscribers. If the number of subscribers increases by 1%, then the average minutes of use per subscriber will be decreased by 0.725%. Correlation value below 1 means total minutes of use in mobile services still increase as the number of subscribers increase even if minutes of use per subscribers decrease. From the estimation, it can be seen that the price elasticity is lower than 1 as suggested by various international studies, e.g. Lee and Lee (2006) found that the price elasticities of mobile service demand in Korea estimated from GLS method were in a range of -0.4 to -0.9.

Estimated values from equation (17) are used to determine the consumer surplus in equation (14). The virtual price (the maximum price that makes the demand closes to zero) is calculated to be at 516 Baht/minute. Subsequently, the consumer surplus per subscriber can be calculated from this virtual price and the total consumer surplus can be estimated from the following equation.

$$\text{Total consumer surplus} = \text{Consumer surplus per subscriber} * \text{number of subscribers} * 3 \quad (18)$$

The change in consumer surplus (ΔCS_{Total} , QoQ) can be calculated and results are shown in table 4. Also, table 4 includes changes in consumer surplus due to the price changes (P) calculated from equation (13) and total revenues of the industry calculated from the equation below.

$$\text{Total Revenues} = \text{ARPU} * \text{SUB} * 3 \quad (19)$$

The Consumer surplus ratio (CS Ratio) can be calculated from the below equation.

$$\text{CS Ratio} = \text{Total consumer surplus} / \text{Total revenues} \quad (20)$$

Figure 9 and table 4 shows calculated results from the above equations.

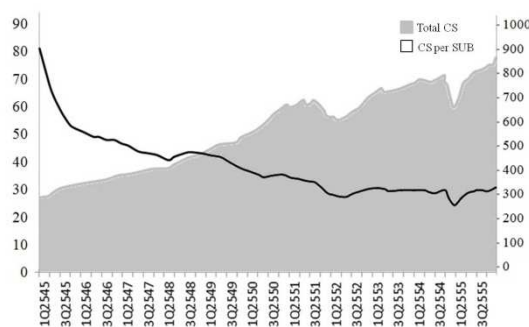


Figure 9: Consumer Surplus per Subscriber and Total Consumer surplus in Mobile Business

Source: Estimations are from equation (18) and data of the number of subscribers are from Thai Telecom Database

Table 4: Consumer Surplus, Total Revenues, Changes in Total Consumer Surplus and Changes in Consumer Surplus due to Price Changes

Year	CS	Revenues	Ratio (CS/Rev.)	ΔCS_{total}	ΔCS_{Price}
2002	102,891	97,118	1.059		252
2003	123,718	118,982	1.040	20,826	-232
2004	140,000	139,478	1.004	16,283	-99
2005	158,838	140,588	1.130	18,838	1,954
2006	185,091	143,514	1.290	26,252	1,222
2007	218,377	152,813	1.429	33,286	1,405
2008	237,139	153,169	1.548	18,762	-230
2009	236,483	151,380	1.562	-657	59
2010	264,289	160,132	1.650	27,806	153
2011	272,796	173,247	1.575	8,507	-165
2012	293,367	190,006	1.544	20,572	-290
Total	2,232,989	1,620,427		190,476	4,029

Source: Estimations are from equation (18) and data of the number of subscribers are from Thai Telecom Database

Figure 9 shows a decline in consumer surplus per subscriber during 2002 to 2005 that it decreased from 540 Baht per month in Q4/2002 to 462 and 471 Baht in Q4 of 2004 and 2005, respectively. After 2007, the consumer surplus continued to decline to 300 Baht and became stable afterward. (Consumer surplus were at 317 and 327 Baht in Q4 of 2007 and 2012, respectively.)

In contrast, the total consumer surplus continued to increase and the increment was at high during 2005 to 2007. A stable consumer surplus per subscriber after 2007 indicates an increase in consumer surplus due to a rapid growth in the number of subscribers after 2005 and the growth has increased continually as shown in figure 7. In conclusion, the consumer surplus has increased in an average of 19,048 million Baht per year and the highest consumer surplus of 33,286 million Baht occurred in 2007.

The change in consumer surplus due to the price reduction was less than an increase in total consumer surplus. The increase in consumer surplus due to the price reduction occurred during 2005-2007 at the average of 1,527 million

Baht per year. In other periods, the change in consumer surplus due to the price reduction was negligent or became negative.

The change in total consumer surplus continued to increase especially when compared with the revenue, leading to an increase in total consumer surplus ratio. In case of Thailand, the increase in consumer surplus mostly comes from the increase in number of subscribers. As a result, consumers still receive an increased consumer surplus and total minutes of call will continue to increase even if minutes of use per subscriber are stable. It can be concluded that the quantity of mobile services consumed by Thai consumers is constant and the consumers are likely to increase the consumption by increasing the number of subscribers instead of increasing the minutes of use.

In addition, when considering the ratio of total consumer surplus per spending in terms of mobile service charges calculated from $ARPU \times SUB \times \text{number of months}$, this ratio was found to increase from 1.059 in 2002 to 1.548 in 2008. As shown in table 5, Entner and Levin (2005) calculated the consumer surplus for mobile services in USA and found the consumer surplus ratio of 1.47 in 2004 [8]. Hausman calculated and found the total consumer surplus ratio of 1.49 in the mid 2002. When compared to Thailand at the same period in 2002 and 2004, it can be seen that Thailand had lower ratios of 1.059 and 1.004 in 2002 and 2004, respectively, but had similar ratios after 2008.

Table 5: Estimation of Consumer Surplus and Consumer Surplus per Revenues for Mobile Services in USA [8]

Estimate	Consumer Surplus	Revenues	Consumer Surplus/ Revenues
Hausman estimate for mid 2002	\$115 bn pa	\$77 bn pa	1.49
UK Radio Communications Agency estimate for UK	£7.2 bn pa	£5.0 bn pa	1.44
Estimate for end 2004	\$157 bn pa	\$107 bn pa	1.47

In overall, it can be concluded that the consumer surplus for mobile services has increased continuously, especially during 2005 - 2006, resulting in a growth of consumer surplus ratio from 1.0 to 1.5 which is similar to the studies in USA. The main factor leading to the growth of consumer surplus is an increase in the number of subscribers at a higher rate than minutes of use per subscriber. The surplus from an increase in the quantity of service per month due to the price reduction is insignificant and occurred only during 2005 - 2007. This information reflects the effect of changing service providers by consumers in response to the price or demand resulting in an increase in consumption of new subscribers from other providers as opposed to the consumption of the existing subscribers. In addition, the excessive use of consumers with package services may result in higher cost than obtaining the new number. These factors may affect consumer behaviors to seek further satisfaction by subscribing a new number instead of increasing consumption in the existing number.

CONCLUSIONS

The success of telecommunication development can be measured by various key indicators. In this paper, the consumer surplus was adopted to analyze and measure the mobile services in the Thai telecommunication market. The result of the research indicated an increase in consumer surplus based on preliminary assessment on continuing expansion in telecommunication services despite of drop in service charges. The research in this paper is under the research project of The National Broadcasting and Telecommunication commission (NBTC), Thailand.

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